The opinion in support of the decision being entered today was *not* written for publication and is *not* binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte OSAMU YOKOMIZO, YUICHIRO YOSHIMOTO, YOSHIYUKI KATAOKA, SHINICHI KASHIWAI, YASUHIRO MASUHARA, AKIO TOMIYAMA, AKIHITO ORII, KOTARO INOUE, TAKAAKI MOCHIDA and TATSUO HAYASHI

Appeal No. 2006-1808
Application No. 08/470,424
Technology Center 3600

Heard: August 8, 2006

Before FRANKFORT, OWENS and BAHR, *Administrative Patent Judges*.

BAHR, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on appeal from the examiner's rejection of claims 24, 26, 29, 40-43, 50 and 52-63. No other claims are pending in the application.

We AFFIRM-IN-PART.

BACKGROUND

The appellants' invention relates to a method for operating a nuclear reactor in a manner to control the void fraction in accordance with the principle of spectrum shift operation. The principle of spectrum shift operation is as follows. A high void fraction slows the rate of reduction of the total amount of uranium 235 and plutonium 239 but also causes the absolute value of reactivity to decrease. Thus, if the void fraction is maintained high throughout the operation of the reactor, a minimum critical level of reactivity is reached more quickly than when the void fraction is low. Therefore, if the void fraction is lowered at the point when the minimum critical level of reactivity is reached, the neutrons exhibit increased deceleration effect, such that nuclear fission of uranium 235 and plutonium 239 increases and an acceptable reactivity is obtained. This makes it possible to burn the core material contained in the nuclear fuel substances for an extended period of time before a minimum critical reactivity level is reached. A copy of the claims under appeal is set forth in the appendix to the appellants' brief.

The examiner relies upon the following as evidence of unpatentability:

Kumpf	US 3,528,885	Sep. 15, 1970
Sofer	US 3,910,818	Oct. 7, 1975
Matzner	US 5,251,246	Oct. 5, 1993
Nakamura '686	JA 59-220686	Dec. 12, 1984
Nakamura '090	JA 60-031090	Feb. 16, 1985
Ito	JA 61-256282	Nov. 13, 1986

Appellants' admissions on page 25 of the specification as originally filed (AAPA)

We derive our understanding of the three Japanese patent documents from the English language translations obtained by the USPTO, copies of which are in the electronic file of the application.

The following rejections are before us for review.

Claims 24, 26, 29, 40-43, 50, 52, 53, 56-59 and 61-63 stand rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter that is not described in appellants' specification so as to convey to one of ordinary skill in the art that the appellants were in possession of the invention at the time the application was filed.

Claims 24, 26, 29, 40-43, 50, 52, 53, 56-59 and 61-63 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the invention.

Claims 24, 50 and 61 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ito in view of Sofer.

Claims 24, 50 and 61 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nakamura '686 or Nakamura '090 in view of Sofer alone or in view of Sofer and Ito.

Claims 24, 26, 29, 40-43, 50 and 52-63 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Matzner in view of Sofer and Ito.

Claims 24, 26, 29, 40-43, 50 and 52-63 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Matzner in view of Sofer and Ito and further in view of AAPA.

Claims 24, 26, 29, 40-43, 50 and 52-63 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Ito in view of Sofer and Matzner or Kumpf.

Claims 24, 26, 29, 40-43, 50 and 52-63 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nakamura '686 or Nakamura '090 in view of Sofer, either alone or further in view of Ito, further in view of Matzner or Kumpf.

Rather than reiterate the conflicting viewpoints advanced by the examiner and the appellants regarding this appeal, we make reference to the examiner's answer (mailed November 16, 2005) for the examiner's complete reasoning in support of the rejections and to the appellants' brief (filed February 23, 2004) and reply brief (filed January 17, 2006) for the appellants' arguments thereagainst.

OPINION

In reaching our decision in this appeal, we have given careful consideration to the appellants' specification and claims[1], to the applied prior art, and to the respective positions articulated by the appellants and the examiner. As a consequence of our review, we make the following determinations.

We turn first to the rejection under 35 U.S.C. § 112, first paragraph, as allegedly containing subject matter not disclosed in the specification so as to satisfy the written description requirement. The basis of this rejection is that there is no

[1] In claims 59 and 60, it appears that "descending" in lines 2 and 5 (as reproduced in the appendix to the brief) should be "ascending" and we have interpreted them as such in deciding this appeal. Additionally, it appears that claim 63 was intended to

support in appellants' original disclosure for the limitation of the definition of the fuel cycle in claims 24, 52, 56, 61, 62 and 63. The full explanation of the examiner's position is set forth on pages 4-5 and 19-21 of the answer.

The claim limitation at issue reads "one fuel cycle is an operation period of the nuclear reactor from when fuel assemblies in the nuclear reactor are replaced and operation of the nuclear reactor is started to when the nuclear reactor is stopped for renewing at least one of the fuel assemblies[2] in the nuclear reactor." The sentence bridging pages 15 and 16 of appellants' specification defines one fuel cycle as "operation period of a nuclear reactor from when the fuel in the reactor core is replaced and operation of the nuclear reactor is started to when the nuclear reactor is stopped for renewing the fuel, i.e., usually, one year." Further, the specification informs us, on page 17, that the fuel assembly assumes the condition as shown in Figure 3A (high void volume) for up to about 70% of the fuel cycle and, on page 18, that, by the time the reactor reaches about 70% of the fuel cycle, the surplus reactivity in the reactor core will have been lowered to a minimum critical level and, at that time, the flow rate of the core is gradually increased to 120%. When the flow rate is greater than 110%, the interior of the water rod 19 assumes the condition shown in Figure 3C (single-phase stream with no vapor in the coolant descending path).

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depend from claim 54 rather than from claim 62.

[2] Claims 61, 62 and 63 read "a portion of the fuel assemblies" instead of "at least one of the fuel assemblies."

The disclosures in appellants' specification referred to above appear to provide support for the definition of one fuel cycle recited in appellants' claims 24, 52, 56 and 61-63 and the examiner has not cogently explained why this disclosure in not sufficient. The examiner's concern that appellants' claims somehow indicate that the "renewing" takes place while the fuel assembly is in the nuclear reactor (answer, p. 4) is unfounded. We find no such limitation in the language at issue in appellants' claims. We also note the examiner's discussion (answer, pp. 19-20) of the distinction between the renewing or replacing of fuel and the renewing or replacing of fuel assemblies but find that the evidence as a whole indicates that one of ordinary skill in the art would understand the renewing of a fuel assembly, as alluded to in the claims, to be the same as renewing of the fuel of a fuel assembly, as referred to in the definition of one fuel cycle on pages 15 and 16 of appellants' specification.

We also do not share the examiner's concern (answer, p. 19) that appellants' specification makes no reference to the minimum number of one fuel assembly to be renewed in a fuel cycle so as to provide support for the stoppage for renewing "at least one of the fuel assemblies" in claims 24, 52 and 56. The disclosure in the last paragraph on page 18 of appellants' specification that the fuel assembly experiences the fuel cycle operation four times in the reactor core and the reference to a fuel cell constituted by four adjoining fuel assemblies (specification, p. 19) conveys that the nuclear reactor is stopped after one fuel cycle to renew at least some of the fuel in the fuel assemblies, which fuel assemblies may total at least as

few as four, and is not specific as to whether some portion (i.e., one-fourth) of the fuel is renewed from each of the fuel assemblies after each fuel cycle or whether one-fourth (i.e., one in the case of a four fuel-assembly core) of the fuel assemblies is renewed or replaced after each fuel cycle and the claim language is sufficiently broad to cover either procedure. We find that one of ordinary skill in the nuclear reactor art would be familiar with the pattern of fuel exhaustion in reactor cores and fuel assemblies and conclude that such a person would understand the type of fuel assembly renewal referred to in appellants' claims to be the same type of fuel renewal discussed in appellants' specification.

In light of the above, we will not sustain the examiner's rejection of claims 24, 26, 29, 40-43, 50, 52, 53, 56-59 and 61-63 under the first paragraph of 35 U.S.C. § 112.

We also shall not sustain the examiner's rejection of claims 24, 26, 29, 40-43, 50, 52, 53, 56-59 and 61-63 under the second paragraph of 35 U.S.C. § 112 as being "vague, indefinite, incomplete, misdescriptive and inaccurate in indicating that the renewing of the fuel assembly takes place while the fuel assembly is still in the nuclear reactor" (answer, p. 5). As discussed above, we find no limitation in any of the rejected claims that the renewal takes place while the fuel assembly is still in the nuclear reactor. For the reasons discussed above with respect to the written description rejection, we conclude that one of ordinary skill in the art would understand the fuel assembly renewal referred to in the claims to be the fuel

renewal discussed on page 16 of appellants' specification in connection with the definition of one fuel cycle.

We turn our attention now to the rejections of claims 24, 50 and 61 as being unpatentable over Ito in view of Sofer and over Nakamura '686 or '090 in view of Sofer, either alone or further in view of Ito. For the reasons that follow, we cannot sustain either of these rejections.

Each of these claims require a step of raising a coolant surface formed between the coolant and a vapor in the at least one water rod by increasing the flow rate of the coolant supplied to the core based on increasing a number of revolutions of the pump during one period from a beginning of one fuel cycle and before an end of the one fuel cycle and a step of further increasing the flow rate of the coolant supplied to the core based on increasing the number of revolutions of the pump during another period *after the one period to an end of the one fuel* cycle *in a state in which the at least one water rod is completely filled with the coolant.* Based on our review of appellants' specification, we understand the recited description of the at least one water rod being completely filled with the coolant to describe the zero void fraction situation illustrated in appellants' Figure 3C. These claims require a step of increasing the flow rate of the coolant, by controlling the pump speed, so as to raise a coolant surface formed between the coolant and a vapor in the at least one water rod and, within the same fuel cycle, that is, before the reactor is again stopped for fuel renewal of any of the fuel assemblies, a step of further increasing the flow

rate of coolant, by controlling the pump speed, so as to reach a state wherein the at least one fuel rod is completely filled with the coolant, i.e., a zero void fraction.

Ito's invention is a water rod 2 provided with a flux adjustment part 8 for adjusting the coolant flux through the fuel assembly and a cross-shaped cut at its upper end consisting of a shallow cut and a deeper cut at right angles to one another. The flux rate is adjustable by rotation of the water rod 90 degrees to align either the shallow cut or the deeper cut with the bar 16 of the water rod penetration part, thereby either raising or lowering the water rod 2 and flux adjustment part 8. Consequently, the coolant flux in a flow passage in which the coolant flows near fuel rods can be adjusted without extracting the fuel assembly charged into a reactor core in a light water cooling type atomic reactor.

Ito discusses the same spectral shift principle on which appellants' invention is based and discloses decreasing coolant flux during the first half of an "operation cycle" (translation, p. 7) or "combustion cycle" (translation, p. 5) to increase void rate and increasing coolant flux to decrease void rate so that coolant is filled into the water rods (translation, p. 5), i.e., the void rate is made zero (translation, p. 6), during the second half of the "operation cycle" or "combustion cycle." The examiner and appellants disagree as to whether the "operation cycle" or "combustion cycle" referred to by Ito is the same as the "one fuel cycle" recited by appellants or whether Ito's "operation cycle" or "combustion cycle" is made up of multiple fuel cycles as defined by appellants. Appellants point to Ito's Figure 3, which illustrates the small flux period occurring during "the first cycle" and "the

second cycle" and the large flux period occurring during "the third cycle" and urge that the "operation cycle" or "combustion cycle" referred to by Ito, during the first half of which the void rate is increased and during the second half of which the void rate is decreased to zero by increasing the coolant flux, is not a fuel cycle as defined by appellants but a residence time which is several fuel cycles (brief, p. 23). According to appellants, one skilled in the nuclear reactor art would understand that the renewal of the fuel assembly in the core is carried out at the end of each of the first, second and third cycles referred to in Figure 3.

Ito (translation, p. 11) indicates that Figure 3 is a characteristic diagram showing the effect of the present invention (change in the degree of combustion of the infinite multiplication factor). Ito's description of Figure 3, as set forth on page 7 of the translation, is as follows:

> Figure 3 shows a change in the degree of combustion of an infinite multiplication factor signifying reactivity. In the figure, using the method that adjusts the total reactor core flux per cycle, a loss is caused in the effect of the spectral shift to the increase of reactivity.

Ito points out that "[t[he fuel assembly remains for several cycles in the reactor core" (translation, p. 8) and states that "[a]ccording to the conventional method, for each fuel assembly, since the void rate is decreased during the second half of the operation cycle of the entire reactor core residence period, the generation efficiency of plutonium is lowered" (translation, p. 7). Ito's reference to the second half of the operation cycle of the *entire reactor core residence period* appears to equate

operation cycle with entire reactor core residence period. Further, Ito states that the invention pertains to a fuel assembly suitable for improving economical efficiency of a fuel by changing the liquid to vapor ratio in a coolant flow passage part (flux adjustment part 8) *at the first half stage and the second half stage of the fuel combustion* by adjusting the coolant flux of the coolant flow passage part (translation, p. 2). This suggests that the timing of the flux adjustment is the same in Ito's invention as in the conventional method discussed by Ito.

Based on our review of the entirety of Ito's disclosure, it appears that appellants' characterization of Ito's cycle, during the first half of which the void rate is high and the second half of which the void rate is zero, as being a core residence period that is several fuel cycles, as used by appellants, is accurate. In any event, based on Ito's use of the term "operation cycle" in the sense of the entire reactor core residence period and of the term "cycle" in the sense of a fuel assembly remaining in the reactor core for several cycles, the best that can be said of Ito is that it is ambiguous as to whether the cycle during the first half of which the void rate is high and the second half of which the void rate is reduced to zero is a single fuel cycle, as defined by appellants, or several fuel cycles (entire reactor core residence period).

Nakamura '686 and Nakamura '090 each disclose a screw, which may be selectively either installed on the water rod or removed therefrom, for obstructing the flow of water through the water rod, thereby decreasing the flow rate therethrough when it is installed thereon, for adjusting the coolant flow and, thus,

the void fraction. Their disclosure with respect to the timing of the adjustment is essentially the same as that of Ito. In other words, the small flow path screw is used to limit the coolant flow rate during the first and second cycles and the screw is removed in the third cycle so that water fills the water rod. Figure 5 of Nakamura '686 and Figure 6 of Nakamura '090 correspond to Figure 3 of Ito discussed above.

The examiner relies on Sofer for its teaching of reducing the void fraction of the core toward the end of the cycle by increasing the rate at which water is recirculated, as distinguished from Ito's invention, wherein the void fraction is adjusted by adjusting a fluid flow passage near or through the water rod to adjust the coolant flow through each fuel assembly. We note, in this regard, that the conventional method discussed in Ito appears to also adjust the void fraction by adjusting the coolant flux of the entire reactor core, although apparently by adjusting the flux at the beginning of the third cycle.

While, as conceded by appellants on page 24 of their brief, Sofer discloses carrying out the increase of the coolant flow rate in each fuel cycle (note, for example, claim 1 of Sofer), Sofer merely discloses increasing the water recirculation rate between 10 and 30 percent to result in a *lower* void fraction. Sofer does not disclose reducing the void fraction to zero during the end portion of each fuel cycle.

In light of the above, we conclude that Ito and the two Nakamura patents in view of Sofer are insufficient to establish that it would have been obvious to one of ordinary skill in the art to operate a nuclear reactor in the manner set forth in

appellants' claims 24, 50 and 61, namely, by adjusting the pump speed to adjust the void fraction from some non-zero value during a first period in one fuel cycle to zero during another period of the same fuel cycle after the first period to the end of said one fuel cycle. Accordingly, neither the rejection of claims 24, 50 and 61 as being unpatentable over Ito in view of Sofer nor the rejection of claims 24, 50 and 61 as being unpatentable over Nakamura '686 or Nakamura '090 in view of Sofer, either alone or further in view of Ito, can be sustained.

We have reviewed the additional references to Matzner and Kumpf, relied upon by the examiner for their teachings with regard to the use of circulation pumps for pumping coolant through the core of a nuclear reactor and water rod configurations, respectively, as well as appellants' admissions on page 25 of the original specification (AAPA) with regard to flow percentages, but find nothing therein that overcomes the deficiencies of the combination of the Japanese patents and Sofer discussed above. It follows that we cannot sustain the rejections of claims 24, 26, 29, 40-43, 50, 52, 53, 55-59 and 61-63, all of which recite the steps of increasing coolant flow rate from a first level during a first period of one fuel cycle to a higher flow rate resulting in zero void fraction during a second period of the one fuel cycle discussed above, as being unpatentable over Matzner in view of Sofer and Ito; over Matzner in view of Sofer, Ito and AAPA; over Ito in view of Sofer and Matzner or Kumpf; and over Nakamura '686 or Nakamura '090 in view of Sofer, either alone or further in view of Ito, further in view of Matzner or Kumpf.

Claims 54 and 60, however, do *not* recite the specific adjustment steps during one fuel cycle addressed above. Rather, claims 54 and 60, which recite structural details of the water rod cooling path, simply recite a broad step of "controlling the amounts of voids accumulated in the water rods by regulating a number of revolutions of a pump supplying coolant to the core." Accordingly, appellants' arguments with respect to the two-period operation within one fuel cycle, found persuasive as discussed above against the rejections of the other claims on appeal, are not persuasive as to claims 54 and 60, which do not contain these limitations. Appellants do not offer any further or additional argument with respect to the rejections of claims 54 and 60 under 35 U.S.C. § 103(a), instead merely pointing out that claim 54 and its dependent claims recite the feature of controlling void fraction in the water rods by regulating the pump as well as defining the structural features of the fuel assembly and that a plurality of fuel assemblies are loaded in the reactor core and stating that "[t]he features of claim 54 and its dependent claims patentably distinguish from other claims of this application and these claims do not stand or fall together" (brief, p. 29). As set forth in 37 CFR § 1.192(c)(7), in effect at the time appellants' brief was filed, "[a] statement which merely points out what a claim recites will not be considered an argument for separate patentability of the claim." Consequently, appellants have not in fact set forth any argument that applies to claims 54 and 60 in accordance with 37 CFR § 1.192(c)(7) (this provision is now contained in 37 CFR § 41.37(1)(c)(vii)). Accordingly, the rejections of claims 54 and 60 as being unpatentable over Matzner in view of Sofer and Ito; over

Matzner in view of Sofer, Ito and AAPA; over Ito in view of Sofer and Matzner or Kumpf; and over Nakamura '686 or Nakamura '090 in view of Sofer, either alone or in further view of Ito, further in view of Matzner or Kumpf are summarily sustained.

CONCLUSION

To summarize, the rejections under 35 U.S.C. § 112, first and second paragraphs, are reversed. The rejections of claims 54 and 60 under 35 U.S.C. § 103(a) are sustained and the rejections of the remainder of the claims under 35 U.S.C. § 103(a) are reversed. The decision of the examiner is AFFIRMED-IN-PART.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

CHARLES E. FRANKFORT)
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